Robonic Automatic Transfer Switches Operation and Maintenance Manual

November, 1995
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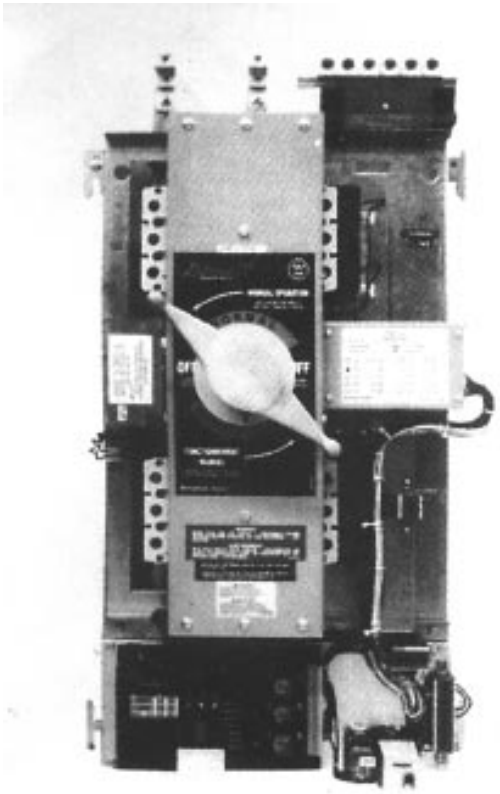

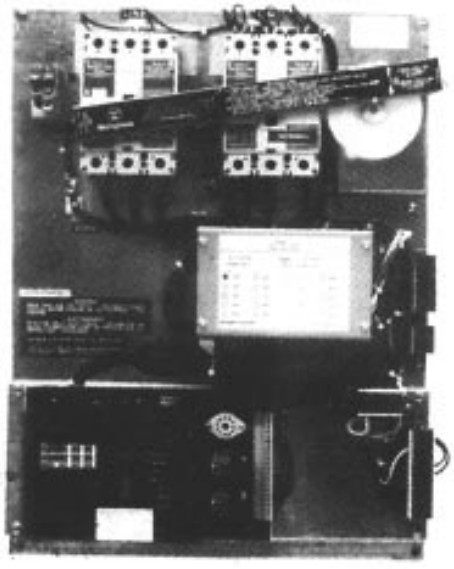

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Robonic TRANSFER SWITCH

CUTLER-HAMMER CANADA
Cutler-Hammer Products
Burlington, Ontario

WARRANTY

The Company warrants the apparatus to be supplied hereunder to be of the kind designated or specified. The Company shall repair or replace any defective part or parts, f.o.b. the Company's factory, repair shop or warehouse, which prove to be defective under normal and proper use within one year from the date of shipment, provided that the Purchaser gives the Company immediate written notice of any such defect or defects. In no event (including, but not limited to the negligence of the Company, its employees or agents) shall the Company be liable for special or consequential damages or damages for loss of use and on expiration of the Warranty period, any liability of the Company shall terminate. This constitutes the only warranty of the Company and no other warranty or condition, statutory or otherwise, shall be implied.

IMPORTANT

'Check equipment for shipping damage immediately on receipt. In case of damage call the carriers concerned at once for inspection, and request an inspection report. Do not write to us first - notify the carrier instead. If this precaution is not taken we cannot assist you in recovering the amount of the claim against the carrier.'

GENERAL DESCRIPTION

CSA Standard C22.2 No. 178-1978 defines an automatic transfer switch as, “self acting equipment for transferring one or more load conductor connections from one power source to another.” The same Standard also gives definitions for type A and type B automatic transfer switches.

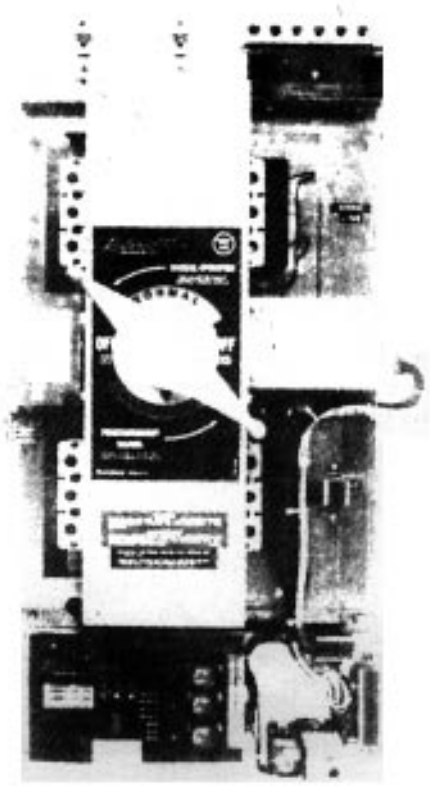
“Transfer switch type A means an automatic transfer switch that does not employ integral overcurrent devices.” “Transfer switch, type B means an automatic transfer switch that (does) employ integral overcurrent protection.” Westinghouse Robonic automatic transfer switches are available in both types. Robonics in type A are equipped with special instantaneous magnetic only interrupter. The trip settings of these special interrupters are set (and fixed) at higher than standard values. They are intended to trip only if the upstream protective device fails to clear a fault. Incorporating these special magnetic only interrupters, a type A Robonic operates in exactly the same way as a transfer switch not having this feature. In the event that both devices trip, the Robonic’s control circuitry will automatically initiate transfer to the alternate source. The transfer operation will reset the “tripped” magnetic only interrupter. Information on Interrupting, Closing and Withstand ratings, for type A Robonics, are given in table 1 on page 5. Type B ‘Robonics’ are equipped with standard thermal-magnetic breakers which will provide the required overload and short circuit protection. Type B Robonics can also be built using electronic breakers which could include ground fault tripping as well as overload and short circuit protection. For application information or assistance with type B Robonics, refer to Cutler-Hammer.

The Robonic provides automatic transfer of an electrical load to a standby power supply in the event of drop or loss of voltage of any or all phases of the normal power supply. Upon the restoration of the normal supply, the electrical load is automatically retransferred to the normal power supply.

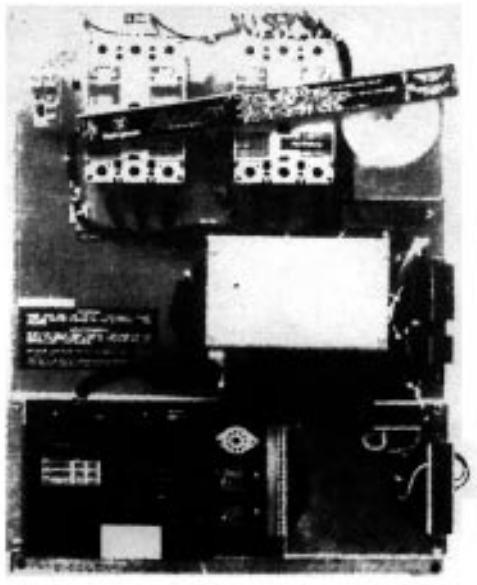
The transfer motor utilizes the power from the source to which the electrical load is being transferred. The mechanism provides a positive mechanical interlock to prevent both breakers being closed at the same time. The mechanism is also designed to leave both breakers trip free in the closed position, permitting incorporation of thermal and short-circuit protection in either or both breakers. In the higher ampacity, type B ‘Robonics’ models, type RO and SPB type an alarm switch contact is supplied. This contact is connected in the transfer motor circuit to lock the motor circuit out of operation when the breaker(s) trip on an overload or short-circuit condition. Then the breaker has to be manually reset. Instructions for the reset procedure are located on the front of the operating mechanism.

All of the control modules in the Solid State Logic Control Panel are plug-in units which are easily replaced.

MECHANICAL COMPONENT IDENTIFICATION



Type RO



Type LRO

TYPE "LRO" ROBONIC AUTOMATIC TRANSFER SWITCH

Rated 30 amperes through 100 amperes at 600 volts Ac maximum 50 or 60 Hertz.

The mechanism is a lever operated device controlled by a 120 volt unidirectional motor.

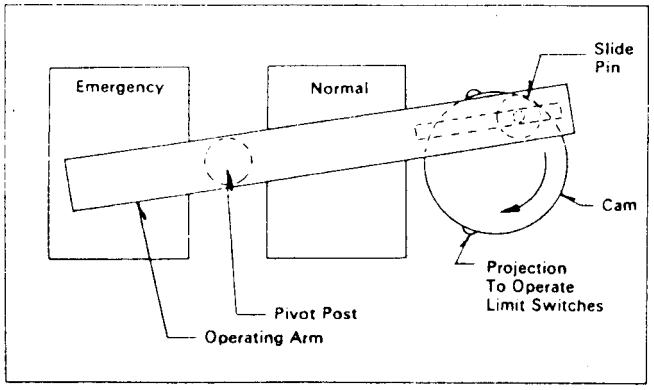
The transfer motor drives a nylon cam which in turn operates a steel lever by sliding a pin along a slot in the back of the lever. The lever, in turn, operates the two breaker handles.

In type A 'LRO Robonics' there are two micro switches (NLS, ELS) inside the breakers which are operated by the breaker's main contacts to disconnect the transfer motor power supply and allow the brake to operate. In type B' LRO Robonics' the distance travelled is determined by two projections on the cam. These projections operate two micro switches (NLS, ELS) which in turn disconnect the power to the transfer motor causing a brake to operate.

The type LRO has three operating positions. They are the normal breaker closed and the emergency breaker open, the emergency breaker closed and the normal breaker open or both the normal and emergency breakers open but never both normal and emergency breakers closed.

The type LRO can also be easily manually operated. Open the lever cover, remove the slide pin and place it in the hole supplied in the lever cover and close the cover. Then the lever can be manually operated for whatever position desired without interference by the automatic control. For automatic control again, simply align the lever slot with the hole in the operating cam and replace the slide pin.

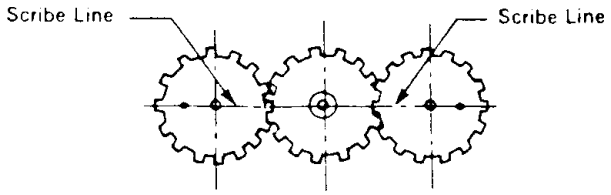
The various automatic control components are described under the section titled "Logic Control".



TYPE "RO" ROBONIC AUTOMATIC TRANSFER SWITCH

A complete line rated from 150 amperes through 1000 amperes at 600 volts Ac 50 or 60 Hertz.

The transfer mechanism consists of the transfer motor, a gear train and two breaker operating cams.



SPUR GEAR MESHING RELATIONSHIP
(Bottom View of Top Cover)

The transfer motor drives the center gear which in turn operates the two secondary gears. There is a projection in the secondary gears which slides in a groove in the operating cams moving the cams from side to side. The breaker handles are set inside two outer guides of the cam and are also moved from side to side. There are two micro switches (NLS, ELS) inside the breakers which are operated by the breaker's main contacts to disconnect the transfer motor power supply and allow the brake to operate.

The type "RO" transfer switch has three operating positions, the normal breaker closed and the emergency breaker open, the emergency breaker closed and the normal breaker open or both the normal and the emergency breakers open but never both the normal and emergency breakers closed at the same time.

The type "RO" transfer switch is also easy to operate manually. Simply remove the transfer motor fuse and turn the operating handle on the front of the transfer mechanism in a counter clockwise direction until you hear the breakers operated and the indicator is in the desired position. There will be no interference from the solid state control. For automatic control again, replace the transfer motor fuse and the Robonic transfer switch will seek the power available.

The various control components are described under the sections titled Logic Control Panels.

TYPE "SPB" ROBONIC AUTOMATIC TRANSFER SWITCH

Rated 1200 amperes through 3000 amperes at 600 volts Ac, 50 or 60 Hertz.

The SPB Automatic Transfer Switch consists of two basic elements:

1. The power switching panel contains the main power contacts and transfer mechanism. The main power contacts connect and disconnect the load to and from the sources of power. The transfer operation is accomplished by the electrically driven, stored energy mechanism of the Systems Pow-R Devices.

2. The logic control panel provides the intelligence/supervisory circuits which constantly monitor the condition of the power sources thus providing the intelligence necessary for the operation of the transfer switch.

The transfer mechanism is energized electrically from the available source and both breakers read "charged" indicating transfer switch is ready for transfer operation. The transfer switch is prepared for the next operation after electrical charging which takes only three seconds after transfer. Manual charging is available if for any reason the transfer switch is not energized. This is done by making either four full strokes on the charging handle, or several partial inching strokes. The transfer switch then can be manually operated.

The switching devices are interlocked to prevent them from being ep, closed at the same time. This is done by means of two mechanical interlocks. Each interlock is connected between the tripping (opening) mechanism of one device and the latching (closing) mechanism of the other device. Therefore if one device is closed its interlock will prevent the other from latching and closing. Both devices cannot be simultaneously connected to the load by either electrical or manual means.

Auxiliary switches are used in remote control circuits for interlocks, indicating lights, and signal contacts to indicate the open or closed position of the breaker main contacts.

The type "SPB" transfer switch has three operating positions, the normal breaker closed and the emergency breaker open, the emergency breaker closed and the normal breaker open or both the normal and the emergency breakers open but never both the normal and emergency breakers closed at the same time.

The type "SPB" Robonic Automatic Transfer Switch is also easy to operate manually.

MANUAL OPERATION FROM NORMAL TO EMERGENCY:

For SPB Automatic Transfer Switches with the four position selector switch, isolate the transfer circuit and engine starting circuit by placing the "FPSS" in the "OFF" position.

For SPB Automatic Transfer Switches without the four position selector switch, isolate the transfer circuit by disconnecting the two inter-connection plugs. Once that is done, push the red "Pushto-Open" button on the Normal Breaker (NB) to open the breaker, then push the green "Push-to-Close" button on the Emergency Breaker (EB) to close the breaker.

With normal source power available, the transfer switch will return to normal when the "FPSS" is returned to the "AUTO" position or when the two control plugs are re-connected.

The various control components are described under the section titled "Logic Control".

Since type A Robonics employ magnetic only breakers, their interrupting, closing and withstand ratings are the same value. Under fault conditions, with its "normal" breaker closed, a Robonic is required to withstand the energy let through of the normal service protective device while the fault is being cleared. At the same time, should the normal voltage fall below the voltage sensing relay's selected value, - and if the alternate source were available, the Robonic could transfer before the normal service protective device cleared the fault.

This would require that the Robonic be capable of interrupting the protective device's let through current. In addition, the Robonic could be required to close in on a fault. Thus can be seen the need for Robonics to have, interrupting, closing and withstand ratings.

The interrupting, closing and withstand ratings shown in Table 1 are those for standard typea Robonics. For higher values, consideration can be given to use of Robonics built with Tri-Pac or Current Limiting breakers.

Table I **Interrupting, Closing and Withstand Rating - Robonic Type A**

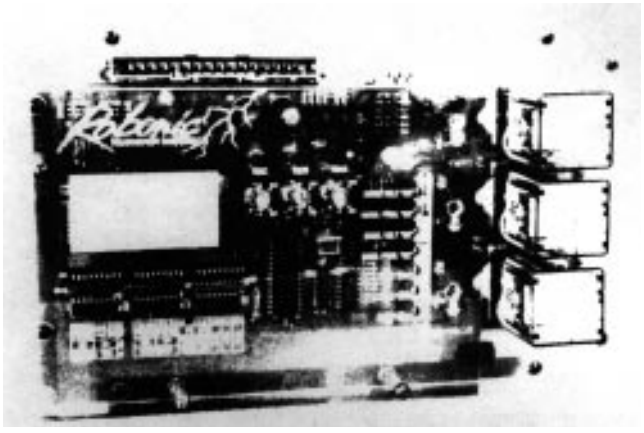
Robonic Continuous Rating	Type	rms symmetrical amperes		
		600 Vac	480 Vac	120,208,240 Vac
30 to 100 amps	LRO	25,000	65,000	100,000
150 to 400 amps	RO	35,000	65,000	100,000
600 lo 1000 amps	RO	25,000	35,000	65,000
1200 to 3000 amps	SPB	85,000	100,000	100,000

Table 2 - Recommended Upstream Circuit Protective Device for Type A Robonics, All Classes of Loads

Robonic		Maximum Upstream	Maximum Upstream Fuse-Rating*	
Type	Continuous Rating (amps)	Breaker Frame Size	Class J or L	Class K5 or R
LRO	30	HFD, FDC, HJD, JDC, FB-P	100	100
LRO	70		100	100
LRO	100		100	100
RO	150	JDC, HKDL, HKD, KDC, HLD, LDC,	225	225
RO	200	LA-P	225	225
RO	225	HKD. KDC, HLD, LDC, LA-P	225	225
	250	HKD, KDC, HLD, LDC, LA-P	400	400
RO	300	HKD, KDC, HLD, LDC, LA-P	400	400
RO	400	HLA, HLC, LD, HLD, NB-P	400	400
RO	600	HMA, HMC, HMD, ND, HND, HNB, NB-P	600	600
RO	800	HNB, ND, HND, HNC, PB, PC, PB-P	800	....
RO	1000	PB, PC, PB-P	1200	....
SPB	800, 1200	PB, PC, PB-P, SPB	2000 (L)	....
SPB	1600, 2000	PB, PC, SPB	3000 (L)	....
SPB	2000, 3000	SPB	4000 (L)	....

*Fuse ratings given are as allowed by CEC. If other ratings are desired, refer to CEC.

MICROPROCESSOR BASED LOGIC CONTROL PANEL



INTRODUCTION

Cutler Hammer's Westinghouse brand of Automatic Transfer Switch Single Board Controller is a microcontroller based transfer switch logic control package. The hardware and software of the controller contains the intelligence / supervisory circuits which constantly monitor the condition of the power sources. It provides the intelligence necessary for the operation of the transfer switch. The single board controller may be used as a replacement for the solid state logic control panel in the existing older version of the Robonic Transfer Switches.

SPECIFICATION

The ATS controller has an operating temperature range of -20 deg. C to +75 deg. C.

The controller circuit board is protected by an insulating conformal coating.

The specification under normal operating condition are as follows:

Tolerance for Voltage Sensing function: +/-2% of setting.
Tolerance for Frequency Sensing function: +/-0.2 Hz of setting.
Accuracy of Time Delay Range: +/-2% of setting.
Dial settings for Delay Time are +/-5% of indication.

OVERALL FUNCTIONAL DESCRIPTION

There are four main groups of functions included in the ATS single board controller.

1. Voltage Sensing Functions

Choices of voltage sensing functions are selectable for Normal and Emergency sources as follows by means of factory programming.

- 1 phase or 3 phase sensing
- Either or both the undervoltage and overvoltage sensing.

Dip switches are used to select the pickup and dropout points for Normal UV, Normal OV, Emergency UV and Emergency OV functions.

For undervoltage sensing function:

- Available pickup settings: 100%, 95%, 90% and 85% of normal;
- Available dropout settings: 5%, 10%, 15%, and 20% from pickup setting.

For overvoltage sensing function:

- Available pickup settings: 105%, 110%, 115% and 120% of normal;
- Available dropout settings: 5%,10%, 15% and 20% from pick-up setting.

2. Frequency Sensing Functions

The controller can be programmed to include either or both the Underfrequency and Overfrequency sensing for the Normal and Emergency Sources.

Dip switches are used to select the normal frequency of the power sources and the pickup points.

The normal frequency settings are 50 Hz or 60 Hz. The dropout points are fixed at 2 Hz differential.

Available pickup settings for the under frequency function are:

- at 60 Hz nominal = 56, 57, 58, 59 Hz
- at 50 Hz nominal = 46, 47, 48, 49 Hz.

Available pickup settings for the over frequency function are:

- at 60 Hz nominal = 61, 62, 63, 64 Hz
- at 50 Hz nominal = 51, 52, 53, 54 Hz.

3. Time Delay Functions

The controller can be programmed to include three different time delay functions - TDNE, TDEN and TDEC. Each timing function has four different timing ranges as shown below. It can be set to any one of the ranges by moving the appropriate dip switches.

- 0.1 sec. to 60 sec.
- 0.16 min. to 10 min.
- 1 min. to 60 min.
- 3 min. to 200 min.

4. On Board Indicators

Ten 'LED" type indicators are installed on the controller's circuit board for the following functions.

Norm Volt -- LED on indicates the voltage level of the Normal Source is within preset limits.

Norm. Freq -- LED on indicates the frequency of the Normal Source is within preset limits.
-- LED flashes indicate the frequency of the Norma(Source is out of preset limits.
-- LED off indicates the Normal frequency sensing option is not installed.

Emer. Volt -- LED on indicates the voltage level of the Emergency Source is within preset limits.

Emerg. Freq -- LED on indicates the frequency of the Emergency Source is within preset limits.
-- LED flashes indicate the frequency of the Emergency Source is out of preset limits.
-- LED off indicates the Emergency frequency sensing option is not installed.

TDNE RUN -- LED flashes indicate TDNE time delay function is in progress.

TDEN RUN -- LED flashes indicate TDEN time delay function is in progress.

TDEC RUN -- LED flashes indicate TDEC time delay function is in progress.

NR ON -- LED on indicates the output relay NR is energized.

ER ON -- LED on indicates the output relay ER is energized.

ECR ON -- LED on indicates the output relay ECR is energized.

ON-BOARD PROGRAMMABLE OPTIONS

ATS Single Board controller can be pre-programmed in the factory with the following ATS control functions on board:

1) Undervoltage sensing on Normal Source
2) Overvoltage sensing on Normal Source
3) Underfrequency sensing on Normal Source
4) Overfrequency sensing on Normal Source.
5) Undervoltage sensing on Emergency Source
6) Overvottage sensing on Emergency Source
7) Underfrequency sensing on Emergency Source
8) Overfrequency sensing on Emergency Source
9) Time Delay Normal to Emergency
10) Time Delay Emergency to Normal
11) Time Delay Engine Cool Down
12) Preferred Source Selection

If a Robonic transfer switch has been installed in the field, any of these options/functions can be added on site by using the factory programmed “Option Key”. Once the choice options are activated by the installed “option key”; the parameter of each function can be setup by positioning the DIP switches labelled SW1, SW2 and SW3 on the controller circuit board. This allows easy field modification of the control parameter settings at the user’s discretion.

Both the pickup, dropout values of the sensing functions and the timing ranges of the time delay functions may be easily changed by following the instructions provided in the later sections.
Controllers shipped from the factory are programmed to the user’s original specification or to the standard pickup and dropout values as follows:

FUNCTION	PICKUP	DROPOUT
Undervoltage	90%	80%
Overvoltage	105%	115%
Underfrequency (6OHz)	58 Hz	56 Hz
Overfrequency (6OHz)	62 Hz	64 Hz
Underfrequency (50Hz)	48 Hz	46 Hz
Overfrequency (5OHz)	52 Hz	54 Hz

Operating Note:

If the controller is to be used as a replacement for the solid state logic control package in an existing Robonic transfer switch, please check the style number labelled on the transformer module. For the Robonic 11 with a control transformer module style No. marked as 16OD997GO1--G24, please replace it with transformer module with style No.3932D65GO1--G26.

CAUTION:

If the controller is to be used for THREE PHASE sensing, you must insure that the sensing signals (Normal or Emergency) are fed by a three phase transformer package. On the Westinghouse brand three phase units sold by Cutler Hammer, the standard is three phase sensing on NORMAL, and single phase sensing on EMERGENCY.

THREE PHASE SENSING ON EMERGENCY IS AVAILABLE ONLY ASA FACTORY INSTALLED OPTION. If in doubt, please contact the factory for assistance.

Instruction for DIP Switch Setting

The DIP switches located and accessed from the bottom-left portion of the control board must be property set according to application requirements. The three DIP switches are labelled from left to right as SW1, SW2 and SW3. All switches are turned ON or OFF by sliding the switch. As you face the DIP switches, slide:

- > To the TOP to turn the switch ON
- > To the BOTTOM to turn the switch OFF

Always look for the ON and OFF designations on the hardware or printed circuit board to be sure you are setting the switches correctly.

The following table shows the selection groupings that can be provided by the three DIP switches.

DIP Switch	Side Switch	Description
SW1	1 2 3 4	Pickup and Dropout values selection for the Normal Source UNDERVOLTAGE SENSING. Refer to Table I
	5 6 7 8	Pickup and Dropout values selection for the Normal Source OVERVOLTAGE SENSING. Refer to Table 2
	9	Line frequency selection ON=60 Hz OFFHz
SW2	1 2 3 4	Pickup and Dropout values selection for the Emerg, Source UNDERVOLTAGE SENSING. Refer to Table 3
	5 6 7 8	Pickup and Dropout values selection for the Emerg, Source OVERVOLTAGE SENSING. Refer to Table 4.
	9 1	Pickup and Dropout values selection for the Normal source Underfrequency or/and Overfrequency sensing. Refer to Table 5 and 6.
SW3	2 3	Pickup and Dropout values selection for the Emerg. source Underfrequency or/and Overfrequency sensing. Refer to table 7 and 8.
	4 5	Delay Timing Ranges selection for TDNE function. Refer to Table 9
	6 7	Delay Timing selection for TDEN function. Refer to Table 10.
	8 9	Delay Timing Ranges selection for TDEC function. Refer to Table 11.

NOTE: Table 12 serves as a quick reference for finding the actual voltage level that relates to the percentage of the normal system voltage.

NORMAL SOURCE
Undervoltage Sensing Programming

Table 1
Undervoltage Pickup and Dropout

Pickup (%)	Dropout (%)	SW1-1	SW1-2	SW1-3	SW1-4
100	95	ON	ON	ON	ON
	90	ON	ON	OFF	ON
	85	ON	ON	ON	OFF
	80	0N	0N	0FF	0FF
95	90	OFF	ON	ON	ON
	85	OFF	ON	ON	ON
	80	OFF	ON	OFF	OFF
	75	OFF	ON	OFF	OFF
90	85	ON	OFF	ON	ON
	80	ON	OFF	OFF	ON
	75	ON	OFF	ON	OFF
	70	ON	OFF	OFF	OFF
85	80	OFF	OFF	ON	ON
	75	OFF	OFF	OFF	ON
	70	OFF	OFF	ON	OFF
	65	OFF	OFF	OFF	OFF

EMERGENCY SOURCE
Undervoltage Sensing Programming

Table 3
Undervoltage Pickup and Dropout

Pickup (%)	Dropout (%)	SW2-1	SW2-2	SW2-3	SW2-4
100	95	ON	ON	ON	ON
	90	ON	ON	OFF	ON
	85	ON	ON	ON	OFF
	80	0N	0N	0FF	0FF
95	90	OFF	ON	ON	ON
	85	OFF	ON	ON	ON
	80	OFF	ON	OFF	OFF
	75	OFF	ON	OFF	OFF
90	85	ON	OFF	ON	ON
	80	ON	OFF	OFF	ON
	75	ON	OFF	ON	OFF
	70	ON	OFF	OFF	OFF
85	80	OFF	OFF	ON	ON
	75	OFF	OFF	OFF	ON
	70	OFF	OFF	ON	OFF
	65	OFF	OFF	OFF	OFF

Overvoltage Sensing Programming

Table 2
Overvoltage Pickup and Dropout

Pickup (%)	Dropout (%)	SW1-5	SW1-6	SW1-7	SW1-8
105	110	ON	ON	ON	ON
	115	ON	ON	OFF	ON
	120	ON	ON	ON	OFF
	125	0N	0N	0FF	0FF
110	115	OFF	ON	ON	ON
	120	OFF	ON	OFF	ON
	125	OFF	ON	OFF	OFF
	130	OFF	ON	ON	OFF
115	120	ON	OFF	ON	ON
	125	ON	OFF	OFF	ON
	130	ON	OFF	ON	OFF
	135	ON	OFF	OFF	OFF
120	125	OFF	OFF	ON	ON
	130	OFF	OFF	OFF	ON
	135	OFF	OFF	ON	OFF
	140	OFF	OFF	OFF	OFF

Overvoltage Sensing Programming

Table 4
Overvoltage Pickup and Dropout

Pickup (%)	Dropout (%)	SW2-5	SW2-6	SW2-7	SW2-8
105	110	ON	ON	ON	ON
	115	ON	ON	OFF	ON
	120	ON	ON	ON	OFF
	125	0N	0N	0FF	0FF
110	115	OFF	ON	ON	ON
	120	OFF	ON	OFF	ON
	125	OFF	ON	OFF	OFF
	130	OFF	ON	ON	OFF
115	120	ON	OFF	ON	ON
	125	ON	OFF	OFF	ON
	130	ON	OFF	ON	OFF
	135	ON	OFF	OFF	OFF
120	125	OFF	OFF	ON	ON
	130	OFF	OFF	OFF	ON
	135	OFF	OFF	ON	OFF
	140	OFF	OFF	OFF	OFF

NORMAL SOURCE
Underfrequency Sensing Programming

Table 5
Underfrequency Pickup and Dropout

Pickup (Hz)	Dropout (Hz)	SW2-9	SW3-1
59	57	ON	ON
58	56	OFF	ON
57	55	ON	OFF
56	54	OFF	OFF
49	47	ON	ON
48	46	OFF	ON
47	45	ON	OFF
46	44	OFF	OFF

EMERGENCY SOURCE
Underfrequency Sensing Programming

Table 7
Underfrequency Pickup and Dropout

Pickup (Hz)	Dropout (Hz)	SW3-2	SW3-3
59	57	ON	ON
58	56	OFF	ON
57	55	ON	OFF
56	54	OFF	OFF
49	47	ON	ON
48	46	OFF	ON
47	45	ON	OFF
46	44	OFF	OFF

Overfrequency Sensing Programming

Table 6
Overfrequency Pickup and Dropout

Pickup (Hz)	Dropout (Hz)	SW2-9	SW3-1
61	63	ON	ON
62	64	OFF	ON
63	65	ON	OFF
64	66	OFF	OFF
51	53	ON	ON
52	54	OFF	ON
53	55	ON	OFF
54	56	OFF	OFF

Overfrequency Sensing Programming

Table 8
Overfrequency Pickup and Dropout

Pickup (Hz)	Dropout (Hz)	SW3-2	SW3-3
61	63	ON	ON
62	64	OFF	ON
63	65	ON	OFF
64	66	OFF	OFF
51	53	ON	ON
52	54	OFF	ON
53	55	ON	OFF
54	56	OFF	OFF

NOTE:
Underfrequency sensing and/or Overfrequency sensing functions may be programmed into the ATS Controller through the “Option Program Key”. In the case which both “Uf” and Of” Sensing functions are activated, the same DIP switch settings will be applied to both functions. Two equivalent sizes of sensing hysteresises will be assigned to below and above the system line frequency respectively.

NOTE:
Underfrequency sensing and/or Overfrequency sensing functions may be programmed into the ATS Controller through the “Option Program Key”. In the case which both “Uf” and Of” Sensing functions are activated, the same DIP switch settings will be applied to both functions. Two equivalent sizes of sensing hysteresises will be assigned to below and above the system line frequency respectively.

DELAY FUNCTION PROGRAMMING

TDNE - Time Delay Normal To Emergency

Table 9
TDNE Range Select

RANGE	SW3-4	SW3-5
0.1 sec. to 60 sec.	ON	ON
0.16 min. to 10 min.	OFF	ON
1.0 min. to 60 min.	ON	OFF
3.0 min. to 200 min.	OFF	OFF

TDEN - Time Delay Emergency To Normal

Table 10
TDEN Range Select

RANGE	SW3-6	SW3-7
0.1 sec. to 60 sec.	ON	ON
0.16 min. to 10 min.	OFF	ON
1.0 min. to 60 min.	ON	OFF
3.0 min. to 200 min.	OFF	OFF

TDEC - Time Delay Engine Cool Down

Table 11
TDEC Range Select

RANGE	SW3-8	SW3-9
0. 1 sec. to 60 sec.	ON	ON
0.16 min. to 10 min.	OFF	ON
1.0 min. to 60 min.	ON	OFF
3.0 min. to 200 min.	OFF	OFF

Table 12
Normal System Voltage

	120	208	220	240	380	400	415	480	600	
65%	78	135	143	156	247	260	270	312	390	
70%	84	146	154	168	266	280	291	336	420	
75%	90	156	165	180	285	300	311	360	450	
80%	96	166	176	192	304	320	332	384	480	Std. UV Dropout
85%	102	177	187	204	323	340	353	408	510	
90%	108	187	198	216	342	360	374	432	540	Std. UV Pickup
95%	114	198	209	228	361	380	394	456	570	
100%	120	208	220	240	380	400	415	480	600	
105%	126	218	231	252	399	420	435	504	630	Std. OV Pickup
110%	132	229	242	264	418	440	457	528	660	
115%	138	239	253	276	437	460	477	552	690	Std. OV Dropout
120%	144	249	264	288	456	480	498	576	720	
125%	150	260	275	300	475	500	519	600	750	
130%	156	270	286	312	494	520	540	624	780	
135%	162	281	297	324	513	540	560	648	810	

ADDING EXTRA ON-BOARD PROGRAMMABLE OPTIONS:

When it is desired, extra on-board programmable control options can be added to a Robonic with the single board controller. The list of the installable on-board options are as follows;

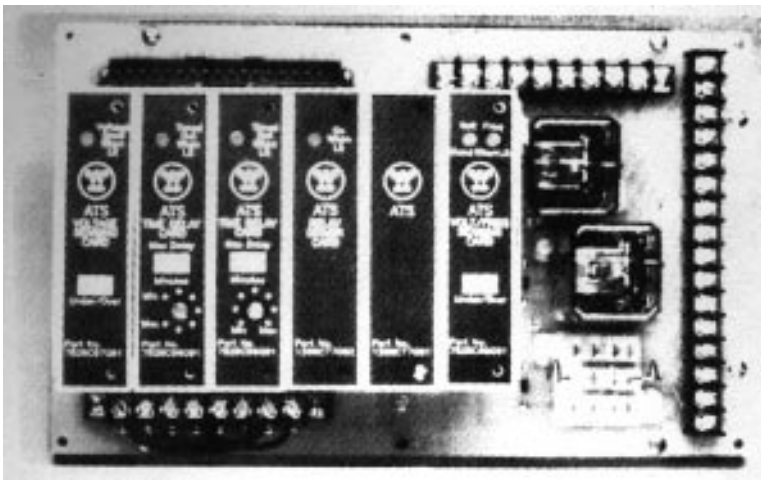
1. Overvoltage sensing on Normal Source.
2. Underfrequency sensing on Normal Source.
3. Overfrequency sensing on Normal Source.
4. Overvoltage sensing on Emergency Source.
5. Overfrequency sensing on Emergency Source.
6. Time Delay Normal to Emergency.
7. Time Delay Emergency to Normal.
8. Time Delay Engine Cool Down.
9. Preferred Source Selection.

After the factory programmed “Option Key” which contains the choice option(s) and the associated parts, if required, are received, turn off the Normal Source and make sure to disable the Emergency Source by turning the Gen set start control to manual. Plug the ‘Option Key” into the 1 0-pin socket (J2) that is located in the centre of the controller circuit board. The Key is not polarized and can be plugged in either way. Install any extra parts if supplied. Turn the Normal Source back on. The new option function(s) will be programmed into the single board controller.

NOTE:

The DIP switches located and accessed from the bottom-left portion of the control board must be properly set according to application requirements for the added control option(s). Please refer to the section that contains the instruction for DIP Switch Setting.

SOLID STATE LOGIC CONTROL PANEL



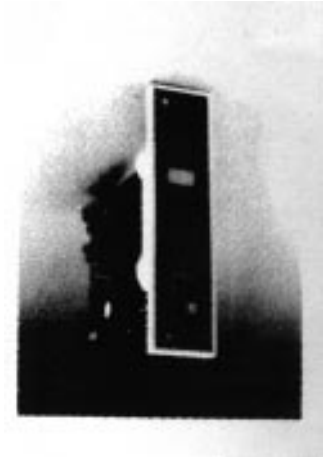
LOGIC CONTROL
VOLTAGE SENSING MODULE

Style Number 782OC97GO1

The module can be programmed to use with 1Ø or 3Ø systems and perform either the undervoltage or the overvoltage sensing function. It is applicable to both emergency and normal source monitoring.

1Ø Undervoltage 3Ø Undervoltage
For undervoltage sensing, this card is normally set at an 80% dropout and a 90% pickup.

1Ø Overvoltage 3Ø Overvoltage
For overvoltage sensing, this card is normally set at a 105% pickup and a 115% dropout.



COMBINATION VOLTAGE/ FREQUENCY SENSING MODULE

Style Number 782OC99GO1

The module is designed for use with 1Ø or 3Ø systems and can be programmed for either undervoltage or overvoltage and either Underfrequency or Overfrequency. It is applicable to both emergency and normal source monitoring.

1Ø Undervoltage 3Ø Undervoltage
For undervoltage sensing, this card is normally set at an 80% dropout and a 90% pickup.

1Ø Overvoltage 3Ø Overvoltage
For overvoltage sensing, this card is normally set at a 105% pickup and a 115% dropout.

1Ø Underfrequency 1Ø Overfrequency
For underfrequency or overfrequency sensing, the card is factory calibrated at 50 or 60 Hz. The standard values of pickup and dropout are as follows:

Type	**System Frequency Hz**	**Pickup Hz**	**Dropout Hz**
Underfrequency	60	58	56
Underfrequency	50	48	46
Overfrequency	60	62	64
Overfrequency	50	52	54

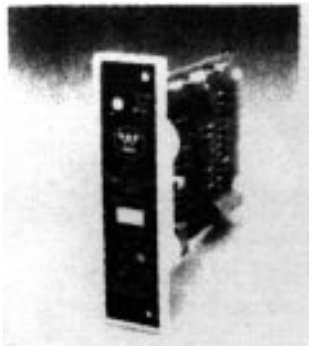
TIME DELAY MODULE

Style Number 782OC96GO1

Module can be programmed for any one of five timing ranges:

1 - 60 sec. timer
4 -240 sec. timer
0.13- 8 min. timer
0.5 - 32 min. timer
1 - 64 min. timer

All can be used to accomplish TDEC, TDEN and TDNE functions.



RELAY DRIVER

Style Number 1266C77GO2

This card is used in place of any of the timing modules when instantaneous operation is required.

BLANK

Style Number 1266C77GO1

Use to cover any unused card slots.

All Cards Mechanically Interlocked

All cards are interlocked mechanically to prevent insertion into the wrong function slot. All cards have a repeat accuracy over a 20 to + 60°C temperature change of ± 3%. Dial settings are ± 10% of indication.

After making adjustments, tighten mounting screws (screws are not captive).

Programming and adjustments for plug-in sensing control modules.

TIME DELAY MODULE

Style Number 782OC96GO1

The Timer Card is a multi-range timer. The card may be used as a replacement for older single range timer cards in existing equipment.

The card may be "programmed" for any one of five timing ranges by simply moving a jumper to the appropriate position. The actual time desired is then set with a front accessible potentiometer.

Programming the Timer Card

1. If the Timer Card must be removed from a Transfer Switch that is in service, it is a good idea to disable the logic first by separating the logic disconnect plug, so that a possibly undesired transfer is avoided.

   CAUTION: Disconnecting the logic WILL cause the Engine Generator to start unless it has been disabled.

2. The card is supplied with a single jumper, which must be placed on the Range Select Terminals as follow:

RANGE SELECT	TIMING RANGE *
1	1 - 60 Seconds
4	4 - 240 Seconds (.07 - 4 Min.)
8	8 - 480 Seconds (.13 - 8 Min.)
32	.5 - 32 Minutes
64	1 - 64 Minutes

***NOTE:** Timing ranges shown are guaranteed. Actual available range may be slightly larger.

VOLTAGE SENSING MODULE

Style Number 782OC97GO1

The card may be used as a replacement for older versions of the plug-in cards in existing equipment.

The card may be "programmed" to perform a voltage sensing function, either undervoltage or overvoltage.

Programming of the card is accomplished by positioning jumpers on the positions labelled J1 through J7 on the board itself. This allows easy filed modification of the card at the user's discretion. Both the function and the pickup and dropout values may be easily changed by following the instructions provided.

Cards shipped from the factory are programmed to the user's original specification, or to the standard pickup and dropout values as follows:

FUNCTION	PICKUP	DROPOUT
Undervoltage	90%	80%
Overvoltage	105%	115%

Programming the card

Reprogramming of the card may be accomplished by using the attached instructions with Table 13 and 14 or Table 13A and 14A.

It is recommended that you remove ALL jumpers from Jl through J7. As supplied from the factory there are erictigh jur-npers to program the card for any function and value.

The card may be programmed for either UNDERVOLTAGE or OVERVOLTAGE. Attempting to program the card for both voltage sensing functions at the same time **WILL CAUSE THE CARD TO MALFUNCTION AND POSSIBLY DAMAGE THE ELECTRONICS ON THE CARD!!**

NOTE:
If the card is to be used as a replacement for older versions of the plug-in cards in existing equipment, please check the Date Code that is stamped on the nameplate of the Control Transformer Module (16OD997GO1-G24).

* For Robonics with control transformer module's date code dated AFTER Sept. 1/92, follow Table 13 and 14 to program the voltage sensing function.

* For Robonics with control transformer module's date code dated BEFORE Sept. 1/92, follow Table 13A and 14A to programme the sensing function.

COMBINATION VOLTAGE/FREQUENCY SENSING MODULE

Style No. 782OC99GO1

The card may be used as a replacement for older versions of the plug-in cards in existing equipment.

The card may be "programmed" to perform a voltage sensing function, either undervoltage or overvoltage; and a frequency sensing function, either underfrequency or overfrequency.

Programming of the card is accomplished by positioning jumpers on the positions labeled Jl through J12 on the board itself. This allows easy field modification of the card at the user's discretion. Both the function and the pickup and dropout values may be easily changed by following the instructions provided.

Cards shipped from the factory are programmed to the user's original specification, or to the standard pickup and dropout values as follow:

FUNCTION	PICKUP	DROPOUT
Undervoltage	90%	80%
Overvoltage	105%	115%
Underfrequency (60 Hz)	58 Hz	56 Hz
Overfrequency (60 Hz)	62 Hz	64 Hz
Underfrequency (50 Hz)	48 Hz	46 Hz
Overfrequency (50 Hz)	52 Hz	54 Hz

Programming the card

Reprogramming of the card may be accomplished by using the attached instructions with table 13, 14, 13A, 14A, 15 and 16.

It is recommended that you remove ALL jumpers from Jl through J12. As supplied from the factory, there are enough jumpers to program the card for any function and value.

The card may be programmed for either UNDERVOLTAGE or OVERVOLTAGE, and either UNDERFREQUENCY or OVERFREQUENCY. Attempting to program the card for two voltage sensing or two frequency functions ... **WILL CAUSE THE CARD TO MALFUNCTION AND POSSIBLY DAMAGE THE ELECTRONICS ON THE CARD!!**

NOTE:
If the card is to be used as a replacement for older versions of the plug-in cards in existing equipment, please check the Date Code that is stamped on the nameplate of the Control Transformer Module (16OD997GO1 - G24).

* For Robonics with control transformer module's date code dated AFTER Sept. 1/92, follow Table 13 and 14 to program the voltage sensing function.

* For Robonics with control transformer module's date code dated BEFORE Sept. 1/92, follow Table 13A and 14A to program the voltage sensing function.

UNDERVOLTAGE PROGRAMMING

1. Place a jumper on J6.

2. Insure that there is NOT a jumper on J7.

3. Choose the desired pickup and dropout values from TABLE 13 and place jumpers on the pins indicated.

4. For THREE PHASE sensing, place jumper on Jl (see CAUTION below).

Table 13
Undervoltage Pickup and Dropout

PICKUP (%)	DROPOUT(%)	JUMPERS
95	90	J2
	85	J2, J4
	80	J2, J5
	75	J2, J4, J5
90	85	J3
	80	J3, J4
	75	J3, J5
	70	J3, J4, J5
85	80	J2, J3
	75	J2, J3, J4
	70	J2, J3, J5
	65	J2, J3, J4, J5

CAUTION:
If the card is to be used the THREE PHASE sensing, you must insure that the sensing signals (Normal or Emergency) are fed by a three phase transformer package. On Westinghouse brand three phase unit sold by Cutler-Hammer, the standard is three phase sensing on NORMAL, and single phase sensing on EMERGENCY.

THREE PHASE SENSING ON EMERGENCY IS AVAILABLE ONLY AS A FACTORY INSTALLED OPTION. If in doubt, contact the factory for assistance.

OVERVOLTAGE PROGRAMMING

1. Place a jumper on J7.

2. Insure that there is NOT a jumper on J6.

3. Choose the desired pickup and dropout values from TABLE 14 and place jumpers on the pins indicated.

4. For THREE PHASE sensing, place jumper on Jl (see CAUTION below).

Table 14
Overvoltage Pickup and Dropout

PICKUP (%)	DROPOUT(%)	JUMPERS
105	110 115 120 125	none J4 J5 J4, J5
110	115 120 125 130	J2 J2, J4 J2, J5 J2, J4, J5
115	120 125 130 135	J3 J3, J4 J3, J5 J3, J4, J5
120	125 130 135 140	J2, J3 J2, J3, J4 J2, J3, J5 J2, J3, J4, J5

CAUTION:
If the card is to be used the THREE PHASE sensing, you must insure that the sensing signals (Normal or Emergency) are fed by a three phase transformer package. On Westinghouse brand three phase unit sold by Cutler-Hammer, the standard is three phase sensing on NORMAL, and single phase sensing on EMERGENCY.

THREE PHASE SENSING ON EMERGENCY IS AVAILABLE ONLY AS A FACTORY INSTALLED OPTION. If in doubt, contact the factory for assistance.

UNDERVOLTAGE PROGRAMMING

1. Place a jumper on J6.

2. Insure that there is NOT a jumper on J7.

3. Choose the desired pickup and dropout values from TABLE 13A and place jumpers on the pins indicated.

4. For THREE PHASE sensing, place jumper on Jl (see CAUTION below).

Table 13A
Undervoltage Pickup and Dropout

PICKUP (%)	DROPOUT(%)	JUMPERS
95	90 85 80 75	none J4 J5 J4, J5
90	85 80 75 70	J2 J2, J4 J2, J5 J2, J4, J5
85	80 75 70 65	J3 J3, J4 J3, J5 J3, J4, J5

CAUTION:
If the card is to be used the THREE PHASE sensing, you must insure that the sensing signals (Normal or Emergency) are fed by a three phase transformer package. On Westinghouse brand three phase unit sold by Cutler-Hammer, the standard is three phase sensing on NORMAL, and single phase sensing on EMERGENCY.

THREE PHASE SENSING ON EMERGENCY IS AVAILABLE ONLY AS A FACTORY INSTALLED OPTION. If in doubt, contact the factory for assistance.

OVERVOLTAGE PROGRAMMING

1. Place a jumper on J7.

2. Insure that there is NOT a jumper on J6.

3. Choose the desired pickup and dropout values from TABLE 14A and place jumpers on the pins indicated.

4. For THREE PHASE sensing, place jumper on Jl (see CAUTION below).

Table 14A
Overvoltage Pickup and Dropout

PICKUP (%)	DROPOUT(%)	JUMPERS
105	110	J2
	115	J2, J4
	120	J2, J5
	125	J2, J4, J5
110	115	J3
	120	J3, J4
	125	J3, J5
	130	J3, J4, J5
115	120	J2, J3
	125	J2, J3, J4
	130	J2, J3, J5
	135	J2, J3, J4, J5

CAUTION:
If the card is to be used the THREE PHASE sensing, you must insure that the sensing signals (Normal or Emergency) are fed by a three phase transformer package. On Westinghouse brand three phase unit sold by Cutler-Hammer, the standard is three phase sensing on NORMAL, and single phase sensing on EMERGENCY.

THREE PHASE SENSING ON EMERGENCY IS AVAILABLE ONLY AS A FACTORY INSTALLED OPTION. If in doubt, contact the factory for assistance.

UNDERFREQUENCY PROGRAMMING

1. Place a jumper on J8.

2. Insure that there is NOT a jumper on J9.

3. Choose the desired pickup and dropout values from TABLE 15 and place jumpers on the pins indicated.

Table 15
Overvoltage Pickup and Dropout

PICKUP (Hz)	DROPOUT(Hz)	JUMPERS
46	44	none
47	45	J11
48	46	J12
49	47	J11, J12
56	54	J10
57	55	J10, J11
58	56	J10, J12
59	57	J10, J11, J12

OVERFREQUENCY PROGRAMMING

1. Place a jumper on J9.

2. Insure that there is NOT a jumper on J8.

3. Choose the desired pickup and dropout values from TABLE 16 and place jumpers on the pins indicated.

Table 16
Overfrequency Pickup and Dropout

PICKUP (Hz)	DROPOUT(Hz)	JUMPERS
51	53	none
52	54	J11
53	55	J12
54	56	J11, J12
61	63	J10
62	64	J10, J11
63	65	J10, J12
64	66	J10, J11, J12

NOTE:
Please refer to Table 12 (Normal System Voltage) in the previous section. It serves as a quick reference for finding the actual voltage level that related to the percentage of the normal system voltage.

DT AND DTM TIME DELAY RELAYS

Option # 32A and 32B

Ratings -

2 Watts Power Consumption
Input coil Voltage - 120 volts at 50/60 Hertz
Contact Rating - 10 amperes resistive at 120 volts
Operating Temperature Rating - - 30°C to + 65°C
Time Ratings - Various available

The relay is incorporated in the control scheme to stop the transfer switch with both breakers open, This is to allow residual load voltage to decay prior to closing on another supply which could be out of phase. When the timing cycle is complete, the relay reinitiates transfer to the available source.

TIME DELAY ENGINE STARTING RELAY

Option # 2A, 2B and 2C

Ratings -

0.75 Watts Power Consumption
Input coil voltage - 120 volts at 50/60 Hertz
Contact Rating - 10 amperes resistive at 120 volts
Time Range - Various available (see below)
Operating Temperature Range - - 30°C to + 65°C

0.5 - 15 sec. time range	S# 5086AOlGOl	Option #2A
4 - 120 sec. time range	S# 5086AOlGO2	Option #2B
10 - 300 sec. time range	S# 5086AOlGO3	Option #2C

TRANSFORMER MODULES

Modules include all necessary control, voltage sensing and logic transformers.

Two versions are available. The standard module has three phase monitoring of the normal source and one phase monitoring of the emergency source. The optional module has three phase monitoring on both the normal and emergency sources.

PLANT EXERCISER

Option # 23A, 23B and 23C

Ratings - Input voltage 120 volts
Contact rating 16 Amps at 250 VAc, 45 - 60 Hz.

150 hour battery back-up
Operating Temperature Range: - 10°C to + 55°C
Accuracy: +/- 4 minutes per year

Description

The Plant Exerciser utilizes a programmable electronic time switch. It incorporates a seven day time base, therefore each day of the week can be uniquely programmed. For convenience, Block Programming is also provided, whereby up to seven days can be grouped together if the “on” and “off” times are the same.

In case of power failure, the built-in nickel-cadmium timer battery maintains the time of day, program storage and LCD display for 150 hours (six days). During this time, output relays are de-energized.

APPLICATION

The Plant Exerciser is a Program Time Switch which functions to start and stop the engine-generator set and transfer switch automatically at pre-selected intervals or times. This electronic timer can be programmed to operate the switch at specific times of the day daily or specific days of the week. The cycle repeats weekly. The Plant Exerciser may be used in two different ways as an accessory for transfer switches.

1. It may be used to simulate an interruption in the normal source of supply at selected intervals, at least once per week, causing the transfer switch components to function, including start-up of the engine-generator set and transfer of load to the generator supply. At the end of the interval it will initiate the transfer back to normal supply and shut down the engine-generator.
   or
2. It may be used to start up an engine-generator set at selected intervals, at least once per week, but without causing the transfer switch to operate and transfer the load to the generator supply. At the end of the interval it will cause the engine-generator to shut-down.

INSTRUCTIONS: TO OPERATE THE ENGINE FOR AN INTERVAL ONCE EACH WEEK, WITH OR WITHOUT OPERATION OF THE TRANSFER SWITCH ...

1. Follow the programming instructions that come with the time switch, set up the actual time of day and the day of the week.

2. Determine the time of day and the day of the week for this test. Program the “ON” command by pressing “CHI” once, and the display will show “CHI ON” and indicate “- - : - -” for the time.

3. Press the “DAY” key to select the desired day of the week.

4. Insert the hour and minutes at which time the “ON” command is to take place, then press the “CHI” key to enter the program.

5. The display will indicate “CHI OFF” and “- - : - -”. Program the “OFF” command by using the steps outlined above

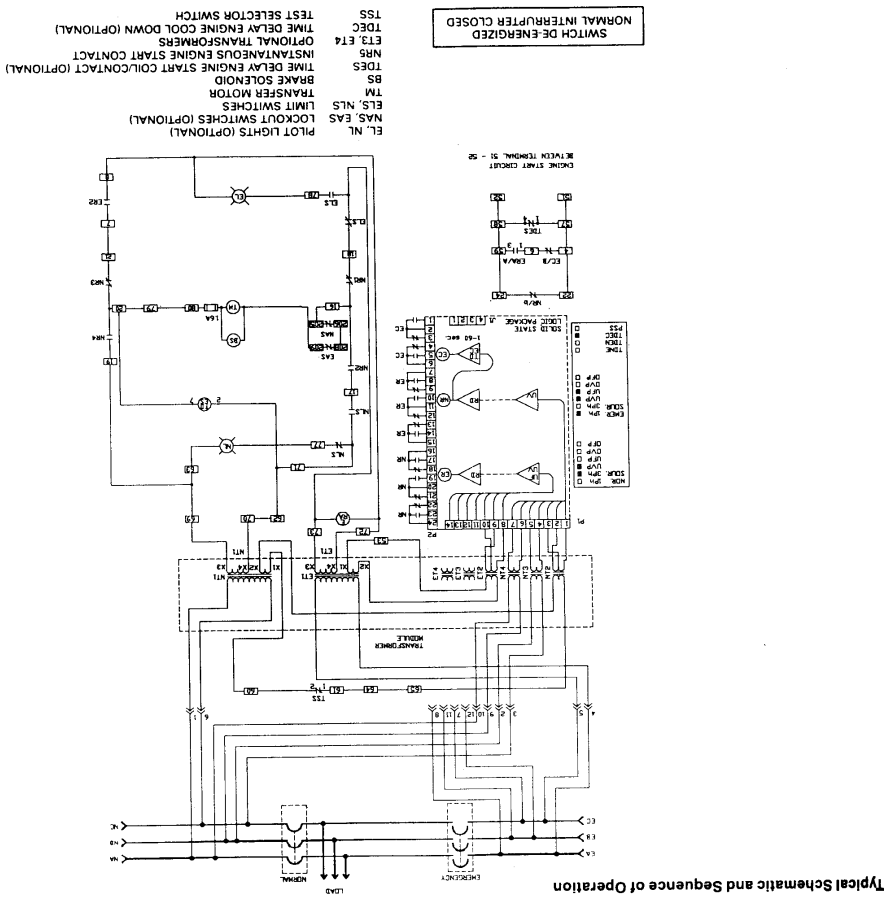
6. Press the “ ◷ ” key to return to actual time of day display. After the time switch is programmed, it will automatically “look back” and assume the correct “ON” or “OFF” switch position.

NOTE:
Regarding changing, checking or canceling programs and manual over-ride switch operations, please refer to the instructions that are provided with the Electronic Time Switch.

PORTABLE TEST KIT

An inexpensive, portable test kit, # 1278C67GO1, is available for convenient field testing and calibration of all plug-in cards and output relays. The only power source required is a 120V convenience outlet. A selector switch allows the operator to test individual cards or to simulate ATS operation by having the source monitoring cards drive the time delay cards which in turn drive the output relays, exactly as in actual use. Calibration checks or changes can thus be accomplished without the necessity of energizing the alternate power source.

TYPICAL SCHEMATIC AND SEQUENCE OF OPERATION


SWITCH DE-ENERGIZED
NORMAL INTERRUPTER CLOSED
EL, NL PILOT LIGHTS (OPTIONAL)
NAS, EAS LOCKOUT SWITCHES (OPTIONAL)
ELS, NLS LIMIT SWITCHES
TM TRANSFER MOTOR
BS BRAKE SOLENOID
TDES TIME DELAY ENGINE START COIL/CONTACT (OPTIONAL)
NR5 INSTANTANEOUS ENGINE START CONTACT
ET3, ET4 OPTIONAL TRANSFORMERS
TDEC TIME DELAY ENGINE COOL DOWN (OPTIONAL)
TSS TEST SELECTOR SWITCH
Typical Schematic and Sequence of Operation

EL, NL	PILOT LIGHTS (OPTIONAL)
NAS, EAS	LOCKOUT SWITCHES (OPTIONAL)
ELS, NLS	LIMIT SWITCHES
TM	TRANSFER MOTOR
BS	BRAKE SOLENOID
TDES	TIME DELAY ENGINE START COIL/CONTACT (OPTIONAL)
NR5	INSTANTANEOUS ENGINE START CONTACT
ET3, ET4	OPTIONAL TRANSFORMERS
TDEC	TIME DELAY ENGINE COOL DOWN (OPTIONAL)
TSS	TEST SELECTOR SWITCH

SWITCH DE-ENERGIZED
NORMAL INTERRUPTER CLOSED

Consider the Robonic in the normal operating position, with normal power available and the normal interrupter closed. The following are energized: U.V. (undervoltage module), TDES (time delay engine start), and NR (normal relay).

The U.V., monitoring all 3 phases of the normal power, senses a dip or loss of voltage which instantly causes NR to deenergize. Contacts NR2 and NR4 open, and contacts NRl and NR3 close. TDES times out, closing its contact and initiating the emergency system start up. When the emergency system reaches correct levels of voltage and frequency, ER is energized and contact ER2 closes. This completes the emergency control circuit, and TM (transfer motor) begins to operate.

First, The normal interrupter is opened, and then the emergency interrupter is closed. At this point, the ELS (emergency limit switch) contacts change state, and the BS (motor brake) closes, preventing TM over travel. The NLS (normal limit switch) contacts change state in preparation for re-transfer to the normal power source.

Upon return of stabilized normal power, NR is re-energized disabling the emergency control circuit, and enabling normal control circuit. The TM operates, opening the emergency interrupter and closing the normal interrupter. When the re-transfer is completed, the NLS contacts change state isolating TM, and BS closes. TDES becomes energized opening its contacts. TDEC times out to allow the emergency generator to run unloaded and cool off before shutting down. The Robonic is now ready to react to another normal power failure.

REPLACING PARTS

The Robonic Automatic Transfer Switch has been designed to have all components accessible and readily removable from the front of the panels. The Robonic Transfer Switch is divided into two basic sections. The upper section consists of the main contacts and transfer mechanism, the lower section consists of all the automatic control devices.

CAUTION

When replacing any parts of the mechanism, control transformers or breakers, isolate the Robonic Transfer Switch from any possible source of power.

To remove the transfer mechanism of the LRO transfer switch, first open the cover and remove the slide pin from the operating cam, then remove the centre bolt, the mechanism will lift straight off. The breakers and transfer motor bracket are held by four screws for ease of removal and replacement. When replacing the mechanism, first set it on the Robonic with the breaker handles in the holes provided and then fasten the centre bolt reasonably tight with the mechanism fully movable with an equivalent swing distance up and down.

To remove the transfer mechanism of the RO transfer switch, remove the four bolts holding it, taking note of which holes the bolts were in, then lift the mechanism straight off. The breakers are held by two bolts at one end and the bus connectors on the other end. The transfer motor is mounted to the transfer mechanism cover and centre drive gear. When replacing any part of the transfer mechanism, be sure that the scribe lines of the gears are in a straight row (example shown on page 5)

To prevent operation of the transfer switch while replacing the mechanism or components, disconnect all sources of power.

When replacing the mechanism move it about until the breaker toggles fit between the mechanism fingers and then fasten the bolts tightly. To test for proper operation, first operate manually and then connect 120 volt, 60 Hertz supply to motor leads and observe operation for free movement and proper breaker operation.

All Robonic transfer switch breakers and mechanisms have allowed some adjustments for mounting to assure proper operation without slipping or binding. Be sure all hardware is tightened sufficiently before re-energizing any transfer switch.

To replace any of the octal plug-in relays, pull old units straight out and insert the replacement unit. Due to the tight fit of the receptacle and pins, you may have to move the relay about a little to pull it out. **DO NOT INTERCHANGE ANY RELAY WITH ANY OTHERS!**

To replace any solid state logic modules, pullstraight out and insert the replacement unit.

Parts List

Part Name	Style No.
Parts Common to Robonic	
Single Board Controller	
Controller main board c/w standard protection	lB27390HOl
Output relay, used for NR, ER and ECR	3A84214HOl
LEXAN Cover	3A84223HOl
Solid State Logic Control Panel Plug-in Modules	
Timer adjustable, for TDEN, TDEC, TDNE with ranges of 1-60 sec., 4-240 sec., 0.13-8 min. 0.5-32 min., 1-64 min.	7820C96G01
Relay driver - used in place of timers, for instantaneous operation	1266C77GO2
1Ø Frequency sensing module, “UF” or “OF” for “Normal” or “Emergency”	7820C99G01
Frequency/Voltage sensing module	7820C99G01
Voltage sensing module, “lØ” or “3Ø”,”UV” or “OV” for “Normal” or “Emergency”	7820C97G01
Blank cover, for unused module space	1266C77G01
Instantaneous relay, used for NR, ER, and EC	7070A59H0l
Options	
Time delay relay for engine starting, adjustable 0.5-15 sec.	5086A0lG0l
Time delay relay for engine starting, adjustable 4-120 sec.	5086A01G02
Time delay relay for engine starting, adjustable 10-300 sec.	5086A0lG03
DT/DTM Time Delay relay	5086A03H03
Plant Exerciser	lA00815H01
Battery Charger 12V	1259C26G01
Battery Charger 24V	1259C26G03
4 Position s/s fixed	7070A56H01
4 Position s/s keyed	7070A56H02

Transformer Modules	**Standard**	**Optional**
600V, for LRO, RO	3932D65G25	3932D65G26
480V, for LRO, RO	3932D65G04	3932D65Gl4
416V, for LRO, RO	3932D65G03	3932D65Gl3
400V, for LRO, RO	3932D65G22	3932D65G24
380V, for LRO, RO	3932D65G21	3932D65G23
240V, for LRO, RO	3932D65G02	3932D65Gl2
208V, for LRO, RO	3932D65G01	3932D65Gll

For Type LRO Robonic	
Mechanism - FD	833C224G01
Mechanism - CA	833C224G02
Motor Assembly c/w Limit Switch	833C223G01
Motor Assembly no Limit Switch	833C223G02
Motor	lA00684H0l
Operating Cam	688A548G01
Slide Pin	688A731H0l
Limit Switch	688A747H0l

For Type RO Robonic	
Mechanism 150 to 300A	833C226G51
Mechanism 150 to 400A	833C226G01
Mechanism 600 to 1000A	833C226G02
Motor	688A749H03
Solenoid	688A740H01
Brake Shoe Assembly	688A739GO1
Operating Cam - MA/NB	623B814H0l
Operating Cam - KA/LA	572B774H0l
Auxiliary & Limit Switch	688A747H0l

TROUBLE SHOOTING

The Robonic is energized; proceed with care!

A. Gen-Set Does Not Start When Test Switch is Operated and Held in "Test" Position.

1. *Check Operation.* Make sure the Test Selector Switch is held in "test" position longer than the TDES time delay.

2. *Check Engine Controls.* Make sure control is in "Automatic" position. Make sure batteries are charged and connected. Make sure engine start circuit is wired.

3. *Check Wiring.* Make sure the start signal wires from the engine controls are connected to the correct terminals on the Control Panel. See the Schematic/ Wiring Diagram.

4. *Check Signal Circuit.* Disconnect and tape start signal wires. Connect the ohmmeter between the control panel terminals 51 and 52. The reading should indicate an open circuit. Turn the Test Selector Switch to "Test" position. After TDES time delay, the ohmmeter should indicate a closed circuit.

B. Robonic Does Not Retransfer the Load After Normal Source is Returned or After Test Switch is returned to "Auto' position.

1. *Check Operation.* Make sure time has passed to allow for TDEN time delay.

2. *Check Normal Source Voltage Levels.* On a three phase system voltmeter should read phase to phase voltage.

3. *Check Signal Circuit.* Confirm that the Test Switch has reclosed to measuring 0 volts between terminals T60 and T61.

C. With Gen-Set Running, Robonic Does Not Transfer the Load to Emergency.

1. *Check Operation.* Make sure time has passed to allow for TDNE time delay.

2. *Check Engine Controls.* Check generator output frequency and voltage. Output should be at least 90% of nominal voltage and 95% of nominal frequency. Make sure generator output circuit breaker is closed.

3. *Check Wiring.* Voltmeter should read phase to phase voltage between Transfer Switch EA and EB.

D. Robonic Retransfers the Load, but Gen-Set Continues to Run.

1. *Check Operation.* Make sure time has passed to allow for TDEC time delay.

2. *Check Engine Controls.* Make sure engine starting control is in the "Automatic" position.

3. *Check Signal Circuit.* Disconnect and tape start signal wires which are connected to the control panel terminals 51 and 52. Connect ohmmeter between these terminals; reading should indicate an open circuit.

RECOMMENDED MAINTENANCE

1. DO NOT perform dielectric tests on the equipment with the control components in the circuit.

2. DO NOT use loctite.

3. Check lubricant in high speed bearings of the motor and the low speed bearings of the gear box. For lubrication use Dow Corning Silicon DC44 or equivalent on the high speed bearings and Aero Shell No. 6 grease or equivalent in gear box after 5000 operations.

4. Check if control components are tight in sockets.

5. Periodically inspect all terminals (load, line and control) for tightness. Re-tighten all bolts, nuts and accessible hardware. Clean or replace any contact surfaces which are dirty, corroded or pitted.

6. Robonics should be in clean, dry and moderately warm locations. If signs of moisture are present, dry and clean transfer switch. If there is corrosion try to clean it off. If cleaning is unsuitable, replace the corroded parts. Should dust and/or debris gather on the transfer switch, brush, vacuum or wipe clean. DO NOT blow dirt into breaker or terminals.

7. Test the transfer switch operation. While the Robonic is exercising, check for freedom of movement, hidden dirt or corrosion and any excessive wear on the mechanical operating parts. Clean, lubricate or replace parts where necessary.

8. Check all adjustable control components (time delay and voltage sensing relays) for correct settings.

9. If the type "RO" mechanism is removed be sure that the scribe lines on the gears are in line. When reassembling the drive mechanisms, be sure that they are fastened to the correct holes in the frame and that the breaker handles are between the cam fingers. (One breaker has to be on and the other off.)

10. Voltage and/or frequency cards may be removed from a ROBONIC (for servicing, etc.) without disruption of power supply to the connected load. Output relays NR and ER, in combination with their timers or drivers, will continue to provide partial protection. Drop-out voltage is 50%; pickup voltage is 70%.

Note:

When servicing logic control, or transformer module, disable the motor circuit.

TYPE LRO ROBONICS

CAUTION

Do not overtighten the pivot screw inside the operating arm. This screw was correctly adjusted at the factory to provide low friction movement of the operating arm without excessive play.

Do not overtighten the set screw holding the operating cam on the motor shaft.